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XEROX

FILLER METAL, ELECTRODE AND FILLER WIRE FOR SAE 4340 STEEL, 260-292 KSI HEAT TREAT RANGE, EVALUATION OF

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C O N V A I R
FORT WORTH [illegible]

Department 6
FWP 2376-2-53

TEST DATA MEMORANDUM

F-TDM NO. 2690
MODEL B-58
TEST NO. F-8143

TEST: Filler Metal, Electrode and Filler Wire For SAE 4340 Steel, 260-292 KSI Heat Treat Range, Evaluation Of

OBJECT: Determine from tensile and hardness tests of welds in SAE 4340 steel which of six candidate electrodes and filler wires will provide welds heat treatable to the 260-292 KSI strength level.

Test Specimens & Procedure: Weldments for the evaluation tests were made using P & H 4340, BA 91, and Airco Special Electrodes and Oxweld 71, Oxweld MW, and A 613 filler wires.

Welding was done by Convair production welders. The plates for welding were preheated to approximately 450 F and maintained at this temperature during and after welding until stress relieved at 1150 F. Before sectioning for specimens, the welded plates were magnaflux and X-ray inspected.

Transverse tensile specimens and all-weld-metal tensile specimens were obtained from the butt welded plates as shown in Figures 1 and 2, respectively. All the specimens were heat treated by heating to 1550 F, holding 30 minutes, quenching in oil, and double tempering for 2 hours at 400 F. Following heat treatment, the specimens were finish machined to size. The testing was conducted on a 120,000 pound capacity Baldwin universal test machine*.

Results: Test results are tabulated in Tables I and II.

Discussion: The strength range of (260-292) ksi was not consistently obtained with any of the electrodes or filler wires evaluated. Weld joint efficiencies of over 90% or 245 ksi were obtained with both the P & H 4340 electrode and the Oxweld 71 filler wire. Both of these welding materials exhibited very good ductility as measured by percent elongation and reduction of area.

Two of the electrodes evaluated in the transverse weld tests were experimental and only available in limited quantities, and therefore, were not tested as all-weld specimens. The brittle fractures that were obtained with the Oxweld MW filler wire eliminated it from further consideration.

Conclusion: None of the candidate filler materials consistently provided welds in the 260-292 ksi strength range in 4340 plate.

*Strainarate was approximately .003 in./in./min. thru yield.

WITNESS:

BY S. B. Oftsnow

CHECKED [illegible]

DATE 9/6/60

APPROVED [illegible] for G C Wilson

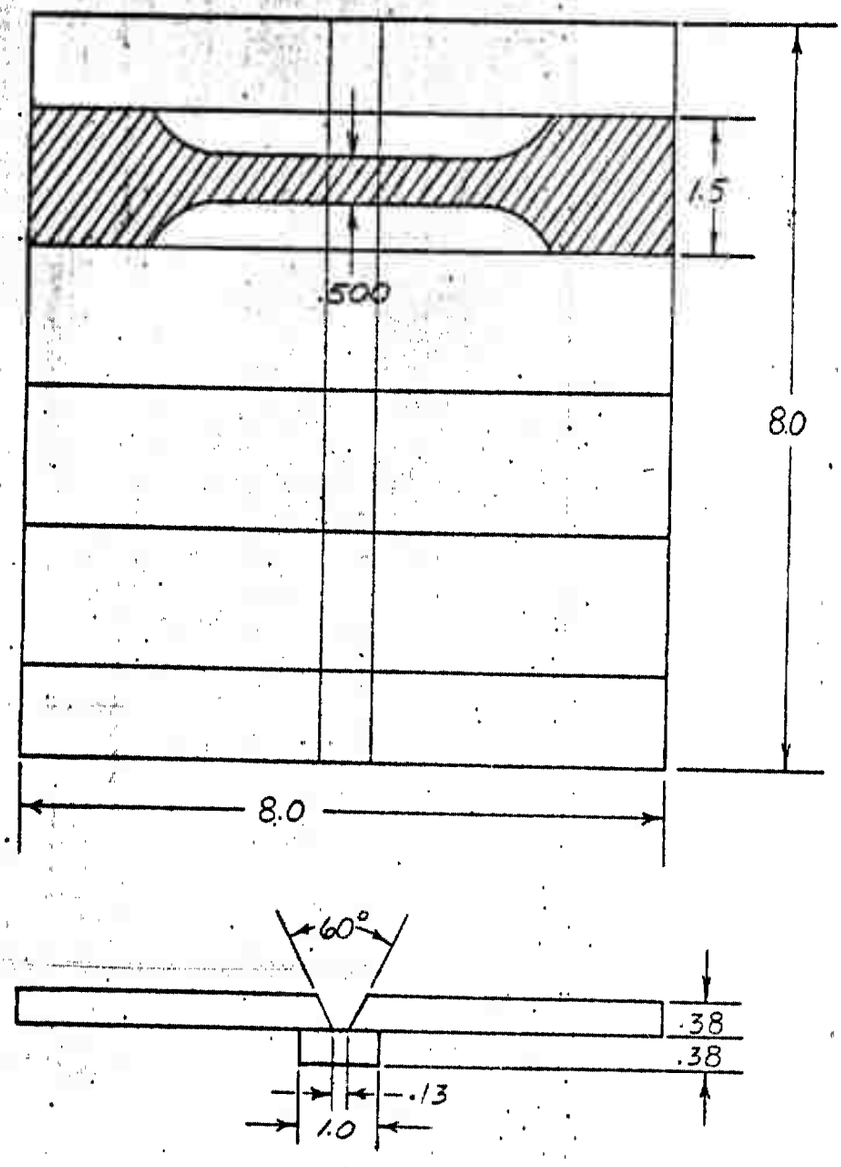

FIG. 1 – TRANSVERSE TENSILE WELDMENT AND SPECIMEN DIMENSIONS.

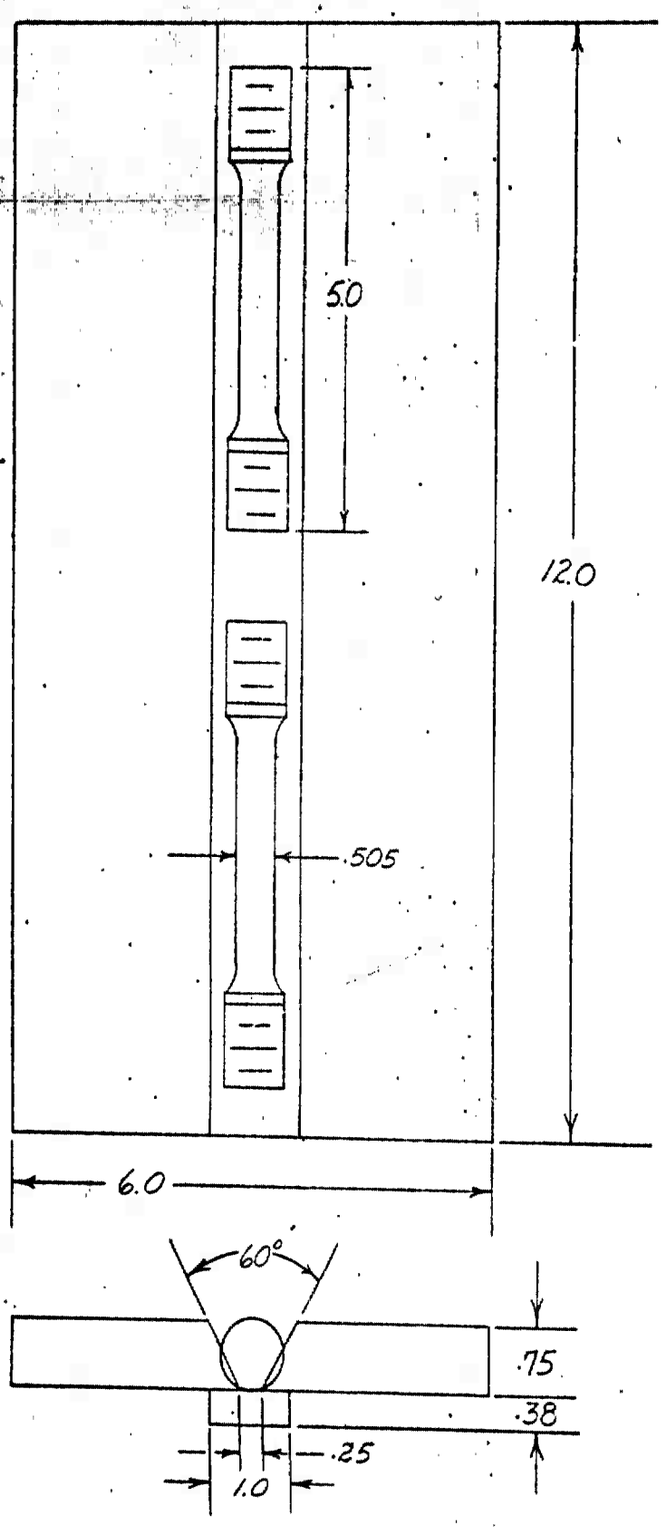

FIG. 2 - ALL-WELD-METAL SPECIMEN LOCATION.

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TABULATION SHEET

TABLE I

MECHANICAL PROPERTIES OF TRANSVERSE WELD TENSILE SPECIMENS

260 - 292 KSI HEAT TREAT RANGE

BASE MATERIAL	FILLER MATERIAL	UTS (KSI)	YTS (KSI)	% ELON. 2" GAGE	BREAK LOCATION	BASE Rc	ULT CONV. (KSI)
4340 STL	PYH 4340	249.6	229.7	2.5	W		
	ELEC.	264.6	227.4	6.5	W		
		244.1	234.0	2.5	W		
AVG.		252.8	230.4	3.8		52.0	273.0
4340 STL	BA 91	257.7	221.6	11.0	W		
	ELEC.	254.9	216.0	5.5	W		
		262.7	219.5	5.0	W		
AVG.		258.4	219.0	7.2		52.0	273.0
4340 STL	AIRCO SPECIAL	252.6	—	6.0	W		
	ELEC.	253.5	—	7.0	W		
		254.5	—	4.0	W		
AVG.		253.5	—	5.7		52.0	273.0
4340 STL	OXWELD 71	246.9	205.5	9.0	W		
	3/32 WIRE	251.8	221.1	7.0	W		
		244.7	210.8	7.0	W		
AVG.		247.8	212.5	7.7		52.0	273.0
4340 STL	A613	246.5	—	4.0	W		
	3/32 WIRE	236.3	—	7.5	W		
		248.4	—	5.5	W		
AVG.		243.7	—	5.7		52.0	273.0
4340 STL	OXWELD MW	237.1	—	1.5	W		
	3/32 WIRE	250.2	—	2.0	W		
		214.4	—	1.5	W		
AVG.		233.9	—	1.7		52.0	273.0

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TABLE II

TABULATION SHEET MECHANICAL PROPERTIES OF ALL-WELD METAL TENSILE SPECIMENS
260 - 292 KSI HEAT TREAT RANGE

BASE MATERIAL	FILLER METAL	FILLER FORM	UTS (KSI)	YTS (KSI)	% ELON. 2" GAGE	HARDNESS Rc	ULT. CONV. (KSI)	% R.A.
4340 STL	P/N 4340	3/32 ROD	246.5	199.0	4.5			11.1
			254.5	202.9	7.0			11.5
			258.2	206.2	7.5			29.3
			245.5	200.0	8.0			29.3
AVG.			251.2	202.0	6.8	49.0	246.0	20.6
4340 STL	P/N 4340	1/8 ROD	271.4	–	8.0			34.1
			260.0	–	4.5			10.0
			260.0	–	8.0			36.0
			260.7	–	6.5			18.6
AVG.			263.0	–	6.8	51.5	268.0	24.7
4340 STL	P/N 4340	5/32 ROD	259.7	–	8.0			37.1
			267.1	214.5	5.5			32.6
			262.2	200.1	8.0			29.3
			255.2	204.4	8.0			33.5
AVG.			261.9	206.3	7.4	49.5	251.0	33.1
4340 STL	OXWELD 11	WIRE (3/32)	251.7	222.2	5.0			34.7
			251.5	221.0	5.0			37.3
			252.5	220.9	5.0			40.5
			253.7	222.7	5.0			36.0
AVG.			252.4	221.7	5.0	49.5	251.0	37.1
4340 STL	A 613	WIRE (3/32)	246.1	222.4	5.0			44.0
			243.7	217.7	7.0			53.9
			245.7	219.7	7.0			51.8
			247.8	222.7	7.0			50.8
AVG.			245.8	221.2	6.5	48.5	242.0	50.1

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